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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubricants— Specification and Classification

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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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Lubricants—Specification and Classification

Specifications of materials are recognized safeguards set up by the purchaser to insure a certain degree of quality and uniformity in materials he receives.

This article atempts to discuss some of the pitfalls and fallacies of restrictive or non-standard purchase specifications which are too often unwittingly applied to petroleum products. It is explained how these can operate to the disadvantage of the purchaser and the discouragement of the supplier.

FIFTY years ago lubrication was relatively simple. Requirements were not severe, lubricants were few and selection of the proper product for a given application presented no problem.

The tremendous technological strides made during the intervening years have changed this picture completely. Countless new requirements have arisen which have been satisfied only by the development of entirely new and different products. Furthermore, the conditions under which the lubricant must operate have become increasingly more severe. The temperature range over which it must perform has been extended greatly in both directions. Loads are heavier, speeds are faster, and tolerances are closer. Also the vast array of new metals and alloys used in the construction of parts that must be lubricated has complicated the problem still further. In addition, the concept of the function of the lubricant has undergone a radical change over the years. Originally it was merely a medium for reducing friction and wear between moving parts. Today a lubricant is a versatile, multi-functional product which not only must perform these primary functions but also is expected to act as a heat transfer medium, protect against rust and corrosion, be a sealing medium, and be a scavenger for all types of contaminants.

In the early days, only two basic types of refined oil were prepared, (1) a low viscosity neutral distillate stock, and (2) a high viscosity bright stock. Quality aspects were limited to viscosity, odor and color. Today the refiner has at his command a flexible and imposing array of refining procedures, all working to produce a uniform, high quality oil from a wide range of crude types.

In many instances, the most highly refined mineral oils or the normal soap-oil type greases do not satisfy completely the requirements of a particular application or kind of service. To meet this situation, the refiners must incorporate *additives* which will supplement or improve the natural properties of the lubricant. The type and amount of addition agent are determined by the nature of the application and service to which the product will be put. For example, in a steam turbine oil small quantities of an oxidation inhibitor, a rust

inhibitor, and an anti-foam agent are adequate to satisfy most severe requirements. On the other hand, gear oils for severe service require additives that will impart extreme pressure characteristics, as well as a pour depressant, a viscosity index improver, and an anti-foam agent. In crankcase oils, addition agents are employed to improve oxidation stability, control engine deposits, provide protection against corrosive wear and rust, and extend the temperature range over which the lubricant will perform satisfactorily. Additives are incorporated in greases to increase oxidation stability, corrosion protection, rust protection, load-carrying properties, melting points, tackiness, water resistance and foam resistance.

Thus the events of the last half century have transformed lubrication from an art into a highly technical science. At the same time, the number of lubricants has grown from a mere handful to literally hundreds of products, many of which are tailor-made for specific applications or conditions.

One of the big problems that confronts a user of industrial lubricants today is the choice of a satisfactory product for a given application. How can he select from the vast number of products available, one or more which will do the job required.

Consumers of industrial lubricants employ a variety of means for determining the product or products which will be purchased for a given application. One of the methods which has been the subject of considerable controversy during recent years is that of purchase specifications.

PERFORMANCE SPECIFICATIONS

Before adopting a specific product, the customer wants to be sure that it will satisfy the requirements of the particular application involved and will perform in accordance with certain preconceived standards. Because of this, as well as other considerations, he may establish a specification which he believes will correlate accurately with the actual performance requirements, and which he will require a product to pass before adopting it. Frequently these specifications will be general and broad, and not too rigid. More often than not, however, they will be specific and restrictive. Usually they will contain one or more non-standard tests developed by the customer to evaluate some specific performance characteristic.

Objections to Performance Specifications

Numerous objections to this method of procuring lubricants have been cited. Some of the more pertinent ones will be restated in the discussion that follows. It should be pointed out that these are basic, empirical objections that may apply to non-standard performance specifications. They do not necessarily all apply to every specification currently employed in the purchase of lubricants. As a rule, the number of objections which fit will increase with the severity of the specification.

Regardless of whether or not it is intended to do so, a performance specification implies that only those products which conform to the established limits will be suitable for the proposed application. This is far from being true. Consider the common occurance of an identical lubrication requirement in two different plants. In each case, the lubricant is purchased on the basis of a specification, but a product which meets one of them does not even approach meeting the other. Thus the products which are being used satisfactorily in one plant cannot be used for the same application in the other plant. This situation is met too frequently by the oil supplier.

With the vast number of lubricants available today, it is not uncommon for a plant to find that it may be stocking a different lubricant for each type of application. It is not difficult to visualize that in a large plant with a diversity of operations, the number of different lubricants used may reach astronomical proportions. When this occurs the plant has a handling problem. As the number of different lubricants increases, the task of keeping them segregated and assuring that a given product reaches its intended application becomes more difficult.

Usually it is not necessary for a plant to carry so many different products. A careful study of the requirements will reveal, in most cases, that one product can replace a number of other products. By such consolidation, the total number of different lubricants in a plant can be reduced to an absolute minimum. Plant management is becoming increasingly more interested in adopting a simplified lubrication plan, and the lubricant supplier is well qualified to assist in this regard. However, it is readily apparent that purchase specifications, unless sufficiently flexible, can raise serious barriers to the accomplishment of this purpose.

It is a matter of record that purchase specifications usually do not keep abreast of product development or lubricant requirements. Thus a specification which at one time may have been satisfactory will now have become obsolete. Many instances have been found where an antiquated specification is being used to qualify a product to lubricate a piece of modern equipment. A situation such as this is certainly not to be recommended. In some cases it even may become dangerous because the product which meets the specification may not be at all adequate to satisfy the need. Even if no harm results, it is almost certain that a product accepted on the basis of an old specification will not be among the most satisfactory that could be obtained for the intended purpose.

Most of the lubricant suppliers are in a position to provide their customers with lubrication engineering service. Such services will include: Assisting in the selection of a proper product for a given application; making a complete study of the lubrication requirements of a plant and preparing a simplified lubrication plan which will keep the number of lubricants to a minimum; working with the customer in solving any problems that might arise in connection with the performance of the lubricant; having his own laboratory make periodic tests on a lubricant in use to check the quality and to establish when the lubricant should be replaced with a fresh charge. These are just some of the routine, every-day services that the supplier offers to assure that his customer's equipment is being and will continue to be lubricated properly. In addition, there are numerous special services that may be made available. For example, it is not unusual for a lubricant supplier to arrange conferences between technical personnel of his own company and those of his customers. As a result of mutual discussions of this type, the technical personnel of the lubricant supplier become more closely acquainted with the lubrication problems of the customer, and consequently they are in a much better position to assist him in their ultimate solutions. Also the customer's personnel invariably learn more about lubrication in general, which knowledge can become invaluable to them in their own duties. Regardless of the outcome of these conferences, the customer stands to profit to a considerable degree.

These and other similar services represent an appreciable expense to the lubricant supplier but are provided gratis to the customer. A specification buyer, by the very nature of his self-imposed restrictions, is in no position to take full advantage of these lubrication engineering services, and has no right to expect the supplier to make them all available to him.

A customer who chooses to select a lubricant by means of strict and limiting specifications must assume the responsibility for the performance of the product. He has established a set of conditions which he believes will enable him to obtain a product that will perform satisfactorily. If trouble occurs and it appears that the product may be at fault, the lubricant supplier has only to prove that the product met the specification. This becomes the limit of his responsibility.

If a specification is to have any meaning, it must be enforced. To do this, both the customer and the supplier must arrange to conduct the various tests which are included in the specification. Such policing can be expensive both to the customer and the supplier. Furthermore, the cost will vary inversely with the amount of product involved. Cases have been found where the cost of testing actually exceeded the cost of the product.

What does the purchaser expect with regard to product performance and how can these performance requirements be measured by means of simple, laboratory tests? This is really the crux of the discussion centering around the application of performance specifications to the purchase of lubricants.

The best means of evaluating the performance characteristics of a particular product is to conduct an actual field test in the very equipment where the product will be used. Almost everyone, purchaser and supplier alike, will agree on this point. However, this procedure frequently is time-consuming and usually presents certain inconveniences to the purchaser. Since he may not care to put up with either the time or inconvenience, he attempts to obtain the same information by the use of simplified, accelerated laboratory tests. He may use some standard test, but more often than not he will devise a test of his own. It is in this regard — predicting product performance by simple laboratory tests — that the supplier and purchaser often fail to see eye to eye.

About ten years ago a special subcommittee was appointed by the A.S.T.M. Committee D-2 on Petroleum Products and Lubricants to prepare purchase specifications for lubricants. This Committee was composed of well-qualified men, representing both suppliers and purchasers. As a result of their studies, the subcommittee reported that "there is not enough reliable information now available as regards test methods to permit writing workable oil purchase specifications which would within themselves, without performance tests, serve as a reliable guide in the selection of lubricants."

If such a statement was true then, it is even more applicable now. As mentioned earlier, lubricants are complex materials, and they are even more so now than they were ten years ago. Much still remains to be learned about lubricants, their properties and their applications. One can talk in terms of generalities about such properties as extreme pressure, detergency, wear-resistance, oxidation-resistance, etc. Physical and chemical tests, accelerated bench tests, and simulated service tests can be employed to help define these properties. However, until a field test is conducted, the actual performance characteristics of a product will not be known.

Perhaps the most important property of an industrial hydraulic oil from a quality standpoint is its oxidation stability. This property may be regarded as the life line of the fluid, since oxidation is the greatest factor that shortens the service life of the oil. As might be imagined, there are many laboratory bench tests that are used to evaluate the oxida-

CLASSIFICATION O

S.A.E. CLASSIFICATION FOR CRANKCASE OILS AND TRANSMISSION AND AXLE LUBRICANTS

The S.A.E. viscosity numbers constitute a classification in terms of viscosity only. Other factors of oil character or quality are not considered. The Saybolt Universal viscosities are the official values. The corresponding Kinematic viscosity values shown below are approximate, and are given for information only.

VISCOSITY VALUES FOR CRANKCASE OILS

SAE Viscosity Number	at 0°F Minimum Saybolt	at 0°F Minimum Centistokes	at 0°F Maximum Saybolt	at 0°F Maximum Centistokes	at 210°F Minimum Saybolt	at 210°F Minimum Centistokes	at 210°F Maximum Saybolt	at 210°F Maximum Centistokes
5W	....	....	4,000	871	....	....	....	....
10W	6,000[a]	1,307	less than 12,000	2,614	....	....	....	....
20W	12,000[b]	2,614	48,000	10,458	....	....	....	....
20	....	....	....	....	45	5.75	58	less than 9.65
30	....	....	....	....	58	9.65	70	less than 12.98
40	....	....	....	....	70	12.98	85	less than 16.82
50	....	....	....	....	85	16.82	110	22.75

[a]Minimum viscosity at 0°F. can be waived provided viscosity at 210°F. is not below 40 seconds Saybolt.

[b]Minimum viscosity at 0°F. can be waived provided viscosity at 210°F. is not below 45 seconds Saybolt.

VISCOSITY VALUES FOR TRANSMISSION AND AXLE LUBRICANTS

SAE Viscosity Number	at 0°F Minimum Saybolt	at 0°F Minimum Centistokes	at 0°F Maximum Saybolt	at 0°F Maximum Centistokes	at 210°F Minimum Saybolt	at 210°F Minimum Centistokes	at 210°F Maximum Saybolt	at 210°F Maximum Centistokes
75	....	....	15,000	3,268	....	....	....	....
80	15,000[a]	3,268	100,000	21,789	....	....	....	....
90	....	....	....	....	75	14.29	120[b]	25.1
140	....	....	....	....	120	25.1	200	42.9
250	....	....	....	....	200	42.9	....	....

[a]the minimum viscosity at 0°F. may be waived if the viscosity at 210°F. is not less than 48 seconds Saybolt.

[b]the maximum viscosity at 210°F. may be waived if the viscosity at 0°F. (extrapolated) is not greater than 750,000 seconds Saybolt.

N.L.G.I. CLASSIFICATION OF GREASES

The National Lubricating Grease Institute has developed a classification system for the majority of greases, which is generally accepted by both manufacturers and consumers today. This system is based on the worked penetration, because the worked penetration is generally more significant than the unworked penetration for greases covered by this specification.

N.L.G.I. Number	A.S.T.M. Worked Penetration
0	355-385
1	310-340
2	265-295
3	220-250
4	175-205
5	130-160
6	85-115

ON OF LUBRICANTS

AGMA STANDARD SPECIFICATION
LUBRICATION OF INDUSTRIAL CLOSED GEARING

This is a proposed revision of the current specification and as such, has not yet been finalized.

VISCOSITY RANGE FOR VARIOUS AGMA LUBRICANTS

AGMA Lubricant No.	Viscosity Range S.U.V. Seconds At 100 deg. F.	At 210 deg. F
1	180 to 240	....
2	280 to 360	....
3	490 to 700	....
4	700 to 1000	....
5	....	80 to 105
6	....	105 to 125
7 Comp.*	....	125 to 150
8	....	150 to 190
8 Comp.*	....	150 to 190
8AComp.*	....	190 to 250

*The oils marked "Comp" are those compounded with 3 to 10 percent of acidless tallow or other suitable animal fat.

FOR ALL ENCLOSED UNITS EXCEPT WORM GEARS

Types of Units / Size of Units / Main Gear Low Speed Centers	Ambient Temperature °F. 15 to 60 Use AGMA No.	50 to 125 Use AGMA No.
Parallel shaft, (single reduction), up to 8"	2	3
Over 8" & up to 20"	2	3
Over 20"	3	4
Parallel shaft, (double reduction), up to 8"	2	3
Over 8" & up to 20"	3	4
Over 20"	3	4
Parallel shaft, (triple reduction), up to 8"	2	3
Over 8" & up to 20"	3	4
Over 20"	4	5
Planetary gear units	2	3
	3	4
Gearmotors	2	4
Spiral, straight or bevel gear units, up to 12"	2	4
Over 12"	3	5
*High Speed Units	1	2

*For speeds over 3600 rpm or pitch line velocities over 4000 fpm.

CYLINDRICAL AND DOUBLE ENVELOPING WORM GEAR UNITS

Worm Centers	Worm Speed Up to RPM	Ambient °F *15-60	Ambient °F 50-125	**Worm Speed Above RPM	Ambient °F *15-60	Ambient °F 50-125
Up to 6" inclusive,						
Cylindrical Worms	700	7 Comp	8 Comp	700	7 Comp	7 Comp
Double Enveloping Worms	700	8 Comp	8AComp	700	8 Comp	8 Comp
Over 6" Centers up to 12"						
Centers, Cylindrical Worms	450	7 Comp	8 Comp	450	7 Comp	7 Comp
Double Enveloping Worms	450	8 Comp	8AComp	450	8 Comp	8 Comp
Over 12" Centers up to 18"						
Centers, Cylindrical Worms	300	7 Comp	8 Comp	300	7 Comp	7 Comp
Double Enveloping Worms	300	8 Comp	8AComp	300	8 Comp	8 Comp
Over 18" Centers up to 24"						
Centers, Cylindrical Worms	250	7 Comp	8 Comp	250	7 Comp	7 Comp
Double Enveloping Worms	250	8 Comp	8AComp	250	8 Comp	8 Comp
Over 24" Centers,						
Cylindrical Worms	200	7 Comp	8 Comp	200	7 Comp	7 Comp
Double Enveloping Worms	200	8 Comp	8AComp	200	8 Comp	8 Comp

*Pour point of the oil used should be less than the minimum ambient temperature expected.

**Worm gears of either type operating at speeds above 2400 rpm or 2000 feet per minute rubbing speed may require force feed lubrication. In general, a lubricant of lower viscosity than recommended in the above table should be used with a force feed system.

TABLE I

Evaluation of the Oxidation Stability of Industrial Hydraulic Oils By Accelerated Bench Tests

Test	A	B	C	D	E	F	G	H
Test Conditions								
Temperature, °F.	300	400	220	225	250	239	260	205
Time, hours	125	96	330	100	168	—	—	—
Aeration	No	Moist air	Dry air	No	No	No	Oxygen	Oxygen
Catalyst	No	No	Copper	Copper, iron	No	Copper	Copper, steel	Copper, iron, water
Relative Ratings of Oils								
Oil No. 1	1	1	2+	1+	2	1	2	4
Oil No. 2	4+	3	1	3	1	3	1	3
Oil No. 3	2	4	4	1+	3	4	3	1
Oil No. 4	3	5	2+	4	4	2	4	5
Oil No. 5	4+	2	5	5	5	5	5	2

tion stability of hydraulic oils. Some of them are static, while others are dynamic; some employ aeration and others do not; some use catalysts and some don't. Also, various end points are employed to compare the oxidation stability of the oils tested. These include the length of time to reach a specified neutralization number increase or a given quantity of sludge; neutralization number increase or the amount of sludge deposited in a given time; pressure drop, or simply visual observation.

The inadequacy of accelerated bench tests to rate the oxidation stability of hydraulic oils is demonstrated rather vividly by the data presented in Table I. This shows the relative rating of five industrial hydraulic oils when evaluated in eight different bench tests. The five oils are premium grade products from five different suppliers, and all have impressive service performance records. The eight laboratory tests are representative of those actually employed by purchasers to qualify hydraulic oils. The oils were assigned ratings of from 1 to 5 to indicate their relative performance in each test. A rating of 1 represents the best, while one of 5 is the worst. The lack of correlation among the various tests is clearly evident from the data presented. Only two of the eight tests (E and G) rate the oils in the same order. Any one oil may rate anywhere from near the top to close to the bottom of the list depending upon the test used. For example, in test B, Oil No. 1 ranks first and Oil No. 3 is fourth. However, in test H their relative ratings are exactly reversed. In tests B and H, Oil No. 4 ranks fifth and Oil No. 5 is second. In tests C and F these ratings are reversed.

The case just discussed represents attempts to evaluate a single property of one product for one application. When one visualizes the vast number of combinations of products, properties, and applications for which similar tests are employed, it is easy to realize that this same situation is multiplied many times over.

Laboratory tests are essential as guides in developing products and in checking uniformity. However, *any single bench test is not a safe guide to service performance* and more often than not can lead to erroneous conclusions. The more complex the lubricant becomes and the more complicated the application, the more difficult it becomes to classify it by means of simple tests.

Thus, of all of the possible objections to the purchase of lubricants by specification this one is the most serious. The practical measurement of the requirements involved is an essential factor in establishing specifications. At the present time, not only is it impossible to measure these requirements by some simple means but also, in many instances, it is very difficult to define the requirements accurately. The attempt to establish standards to control factors about which little is known can be a very dangerous practice. Great strides have been

made in developing an understanding of lubricants and their application. Considerable "know-how" has been accumulated over the years. However, the paths which will lead to the "know-why" are just beginning to be opened. Until much more progress has been made, the adoption of a set of rigid performance specifications upon which to base the purchase of lubricants is not in the best interests of either the purchaser or the supplier.

RECOMMENDED PRACTICE

Unquestionably the consumer does have a problem in the selection of lubricants. Usually he is not an expert on lubricants and their application, and certainly he needs some guide to assist him in choosing the products to lubricate his equipment. There can be no argument against the principle of specification purchasing if the specifications represent an honest attempt on the part of the consumer to obtain products which will serve his needs most satisfactorily. In actual practice, however, they usually fall short of this goal. Where specifications are used as a basis for purchasing lubricants, they should be examined critically and unbiasedly with respect to the objections discussed previously. If the specifications are subject to any of these objections, then the consumer will aid his own cause by revising or discarding them.

In most instances the choice of a lubricant can be based on two entirely separate and distinct considerations, neither one of which bears upon the other, (1) the initial suitability of the lubricant and (2) the quality of the lubricant.

Initial Suitability of the Lubricant

For any given application, the lubricant must have certain basic, physical properties if it is to perform satisfactorily. These properties have no relation to quality, but if they are not observed the product will not function properly regardless of how good it may be.

Usually specifications can be established which will define satisfactorily the basic requirements or the initial suitability of the lubricant for the intended application. Frequently the equipment manufacturer will have specified these requirements. If not, they can be established by consultation with representatives of either the equipment manufacturer or the lubricant supplier or both.

In setting up these initial suitability specifications, only those properties should be included which have an influence on the intended application. Viscosity for oils and penetration for greases will be a "must" for all such specifications. The additional properties included will depend upon the application. For example, in selecting an industrial hydraulic oil, viscosity is the most important single property. If the product will be subjected to wide temperature variations in service, then viscosity index must be taken into account. Likewise, if low temperatures are to be encountered, the pour point becomes a factor. Thus, for an industrial hydraulic oil, viscosity and in some instances viscosity index and pour point are the properties which should be considered in fixing the basic requirements. Properties such as gravity, color, flash point, carbon residue and neutralization number are valuable in checking on the condition of the oil in service, but they are of little or no significance in determining the initial suitability of the oil.

Quality of the Lubricant

The quality of the lubricant reflects its performance characteristics — how well it does the job — and it is the attempt to measure these properties by simple laboratory tests that leads to the disagreements that exist in regard to purchase specifications. As already discussed at length, such tests in themselves are not suitable yardsticks for measuring performance characteristics.

Some time ago the American Petroleum Institute recommended a practice[1] for the purchase of lubricants which has been used successfully for years, and which enables the purchaser to derive the benefits of performance evaluation. This method will assure the selection of products of the desired quality level.

After the basic requirements have been established, the desired standards of performance of the lubricant should be determined for the equipment and operating conditions involved. This can be accomplished by a discussion between qualified personnel of both the supplier and the consumer. After certain performance standards have been established, then the supplier or suppliers are required to meet them with brands whose quality, suitability and uniformity are satisfactory.

Standards of performance usually can be determined by analyzing four factors, namely, the effect of the lubricant on (1) production, (2) maintenance, (3) power, and (4) cost of lubrication.

Effect of the Lubricant on Production

In many instances the level of lubricant quality can be measured directly by the quantity or quality of production. For machines that run continuously for months, time out for lubrication failures or replacement of worn parts may seriously curtail production. In other cases, uniformity of the production is the critical factor. Rejection of material because of inaccuracy, discoloration, or some other reason can reduce production just as effectively as equipment downtime.

[1] Pamphlet "Buy On Performance" by Lubrication Committee, A. P. I.

The Effect of the Lubricant on Maintenance

One of the best measurements of the quality of a lubricant is its effect on maintenance costs. The replacement of worn bearings or gears is costly. A lubricant which will keep such replacements to a minimum will also reduce maintenance costs.

The Effect of the Lubricant on Power

In certain industries, such as textile spinning, friction in thousands of bearings is the principal power-consuming factor. In these plants the performance of a lubricant can be measured by its friction-reducing properties. These properties are always a consideration in determining the suitability of a lubricant for practically all applications, but the relative importance is more dominant in some services than in others.

The Effect of the Lubricant on Cost of Lubrication

As a rule, the total cost for all lubricants is only a fraction of a percent of either the equipment cost or the operating expense. However, frequently this cost is placed first in the mind of the purchaser, and too often is considered on the basis of cents per gallon or per pound. The real cost of lubrication is reflected in the economies effected in production, maintenance and power, in addition to long service life and reduced consumption.

These are four general guides that are helpful in establishing the standards of performance which the purchaser expects the lubricant to meet. Once they have been fixed, then the suppliers can offer products to satisfy them. When a supplier representative makes a recommendation, he puts his reputation and that of his company right on the line. Consequently, that recommendation will have behind it all of the experience and knowledge accumulated over the years by the supplier. A brand name symbolizes the experience, reputation and responsibility of the company behind it, and is one of the most valuable assets that a company can have.

In developing new lubricants, the technical personnel of the supplier use all of the tools at their command in the laboratory to arrive at the best formulation possible. However, before a product is put on the market, it first is field tested extensively to determine its performance characteristics. Thus when a new product is recommended to a purchaser, he can be certain that the supplier has evaluated its performance characteristics. In the case of products which have been available for some time, the supplier invariably can furnish the purchaser with case histories of satisfactory performance in identical applications.

Some purchasers object to specifying brand names for fear that the composition of the product may change without their knowledge. This objection can be overcome simply by having the supplier agree to notify the purchaser of any change in the product composition. The changes then can be discussed to determine their effect, if any, on the application involved.

By following the practice just discussed for the purchase of lubricants, the consumer will be assured of obtaining products which will perform in accordance with his expectations and desires.

A LOOK TO THE FUTURE

Most of the lack of agreement that exists in connection with the specification of lubricants stems from a lack of knowledge. There is still much to be learned about lubricants and lubrication before lubrication requirements can be reduced to some common denominator, and can be evaluated accurately by means of some simple test. Meanwhile, it is to the benefit of all concerned that the knowledge which has been acquired be used to the best advantage. This can be assured only through the wholehearted cooperation of the equipment manufacturers, the consumers, and the lubricant suppliers. They must work together to eliminate, insofar as possible, the many different yardsticks currently employed to measure a given lubrication requirement and agree upon a standardized procedure.

The classification of lubricants according to type or application by the various societies and organizations is a good example of the results that can be obtained by mutual cooperation. These classifications usually are based on the single most important physical property of the lubricant, and are intended to permit a user to select a product whose basic requirements are suitable for the intended application. They have widespread acceptance and can be extremely useful to a purchaser in establishing specifications to define the initial suitability of a product. As a matter of reference, some of these lubricant classifications are presented in the centerspread.

As our knowledge of lubrication increases and as the co-operation among equipment manufacturer, consumer, and lubricant supplier becomes closer, the lack of agreement over the selection and recommendation of lubricants will disappear and be replaced by standards acceptable to all. Until such time arrives, however, a purchaser of lubricants can be assured of obtaining products which will satisfy his requirements by following the practice recommended herein — establish specifications which will govern the basic requirements or initial suitability of the lubricant, then discuss the standards of performance expected with the supplier to assure a product whose quality, suitability and uniformity are satisfactory.

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